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Guidelines for the Design Construction and Operation of Tailing Ponds and Dams

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Tailing dams represent a slightly different condition than conventional water dams in that they may maintain a slurry with a relatively high density and resulting pressure. They may at times be deliberately designed to leak, so that gravity dewatering may occur. These are flow-thru dams. The basic principles that apply to the design of any water dam may be also applied to the design of tailing dams. Pressure is certainly a value that may be estimated with resonable accuracy.

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GUIDELINES FOR THE DESIGN, CONSTRUCTION AND OPERATION OF TAILING PONDS AND DAMS

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Guidelines for the Design, Construction and Operation of Tailing Ponds and Dams

/ The design of water dams is a reasonably well established science requiring a defined series of investigations and design procedures. Tailing dams represent a slightly different condition than conventional water dams in that they may maintain a slurry with a relatively high density and resulting pressure. They may at times be deliberately designed to leak, so that gravity dewatering may occur. These are flow-thru dams. The basic principles that apply to the design of any water dam may be also applied to the design of tailing dams. Pressure is certainly a value that may be estimated with reasonable accuracy.

It is recognized that tailing locations will vary geographically, geologically, hydrologically and climatologically. However, regardless of location, certain sound engineering principles must be applied to the design of the tailing facility. It is not the intent of these guidelines to limit the design of tailing dams and ponds to a generalized standard but rather, to outline those broad engineering principles required.

Further, it is recognized, that in time, controls will be placed on the mining and milling industry on the construction and operation of tailing facilities. The Environmental Protection Agency currently controls effluent discharges from tailing ponds and dams and has determined limitations of concentrations of many parameters with the aid of state agencies, such as state Water Pollution Control Agencies.

Perpetual containment of tailing ponds and dams may eventually be required of the industry. The key factor when abandonment occurs may well be complete compatibility of the disposal area with the surrounding environment. This should be a continuation of compatibility requirements necessary during the life of the project.

Allocation of funds or a bond to insure proper abandonment may be required with the initial filing of construction plans and specifications with the regulatory agency.

It is necessary to stress the need to consider abandonment and final stabilization of the pond and dam area at the time of filing the original design criteria. Rapid runoff without erosion, bypassing and/or removal of rainfall and snow dewatering of solids without stream contamination, stabilization of solids without dust problems, avoidance of harmful slides, all of these must be considered during original design and filing. Certainly they should be considered on existing facilities prior to abandonment. Required design data shown below should be filed with state and regional regulatory agencies such as State Water Pollution Control Agency, Regional Environmental Protection Agency and State Engineer's Office.

Site location is most critical in design and construction of tailing dams. The prime function of most tailing ponds is to store solids not liquids. If toxic or other serious pollutants are involved, then further storage considerations are necessary.

If no effluent treatment is to be used at a proposed property and the effluent cannot meet State or Environmental Protection Agency standards, then special design considerations must be used to contain all tailings.

No discharges will be allowed into streams that do not meet Environmental Protection Agency effluent standards or State Water Quality Standards, whichever is more stringent. Membrane sealing of the pond area may be required to contain toxic or radioactive wastes.

If the site is near a stream or river, location should be above the maximum known flood level. In some cases, where available sites are limited, riprapping may be required to protect from erosion. In many areas, the Corps of Engineers 200 year flood line can be established.

The site location should never be near a heavily traveled road or thoroughfare.

Tailing ponds and dams should never be designed to be an eyesore. They should be made to blend in with the environment. When near civilization, screening of the area should be used. Trees, shrubbery and grasses may be required.

A registered professional engineer proficient in soil mechanics should be retained for design of the tailing dam; or, a registered P.E. and a licensed soil consultant should be used. All findings and data, including design data, should be filed with regulatory agencies shown herein for a permanent record.

Topographic or photogrammetric mapping is an aid and guide to good engineering analysis and should be a part of the permanent record on file.

Complete geologic and hydrologic studies including underground and stream chemical water analyses and soil analyses should be made of the site location and filed with the regulatory agencies for the permanent record.

Foundation and construction soils investigations should include, but not be limited to, grain size and distribution, density, permeability, shear strength, moisture content and plasticity.

No tailing ponds should be constructed over old mine workings, water bearing geologic faults or outcrops. The study of soil in the area can determine closeness of ponds to workings. Deep mining in competent rock usually presents no problem.

Although all original design data should be filed with the regulatory agencies, Owners should also maintain up-to-date files showing constant changes in shape and elevation of the dam and pond.

Design specifications should include provisions for continuous inspection of construction in order that construction conforms with the specifications.

No foundation or starter dams should be constructed with clayey materials which are not impermeable and where the material is in shear and subject to saturation.

Consideration must be given in design to the possibility of earth tremors and liquefaction caused by sonic or other forces. The possibility of foundation subsidence and the stability of surrounding slopes must be investigated. Leaching and erosion to streams or ground water contamination must be avoided. Measures to prevent wave and wind erosion are required.

Permanent water diversions or by-passes or interceptors for storms, rain and snow run-off must be provided in perpetuity. Where ground water is extremely high, ground water drains up gradient of the site, prior to construction, may avoid future leaching of the tailings.

Drain lines, filter blankets, french drains, etc., should be designed for non-plugging operation and for perpetual use.

Decant towers and collector lines should be designed for total saturated loading for compression, shear, and tension and shall have water tight joints to avoid "sucking" fines out of the dam and pond. If decant towers are used, a minimum of two should be required.

If decant collector lines are not large enough for annual visual inspection, TV cameras should be used. A record of inspections should be maintained in Owner's file.

No piping or other structures should be allowed through the dam face, foundation or toe dam, unless location is such as to preclude use of side decant lines or structures or the line cannot be placed under the dam.

If pump barges or syphons are used for water reclamation, a concrete or grouted rip-rap spillway should be provided to avoid overtopping caused by loss of power or loss of syphon.

Water detention time should be long enough to oxidize the more common mill reagents used in the process of mineral recovery.

The higher the dike and the finer the material, the greater are the chances for failure; therefore, cyclones should be used to grade out the coarser fraction for construction.

For small volume ponding, a dam constructed from borrow material may be most economical for construction and operation.

Deposition of any waste material undergrowth or debris in the area should be made away from the tailing pond site. These materials should not be placed in the dam structure. If the top-soil in the area to be covered can be used for future stabilization, it should be stockpiled.

As a matter of good water management, effluent recycling should be practiced whenever possible.

Consideration should be given to recycling solid tailings into old mine workings as back-fill. In some difficult mining locations, this may be the method of economical disposal.

Regular inspections should be made of all installations and provide for inspections to be sure that the operations conform to specifications.

Piezometer wells should be maintained in all dams to measure ground water levels and pore pressures for on-going measurement and analysis.

The slope of the downstream embankments should be designed for eventual planting of vegetation; preferably 1:4 for machine maintenance. A slope of 1:3 is sufficient for low growth not requiring machine maintenance.

Stabilization of surfaces should be made using regional flora wherever possible.

The local Soil Conservation Service, Forest Service or Highway Department should be consulted for aid in stabilization of surfaces with vegetation. Many of the colleges and universities are doing experimental work in reclamation, stabilization and vegetation of surfaces.

Where vegetation cannot be sustained, geologic cover materials, chemical agents or dust palliatives should be used to stabilize the surfaces.

Basic fundamental research is needed on existing tailing dams. Owners should be encouraged to provide criteria for future tailing dam design.

The Owner shall at all times observe and comply with all Federal, State and local laws, ordinances and regulations, which in any manner affect the contract or the work to be done.

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